I claim:

1. The method of controlling the temperature of a process tool with thermal transfer fluid to maintain the tool at a selectable temperature in the range of $-80^{o}C$ to $+60^{o}C$ comprising the steps of:

delivering a first chilled refrigerant having a first boiling point as a liquid-vapor mixture at first refrigeration energy rate,

effecting thermal energy transfer at a selected rate between the first refrigerant and a second refrigerant having a second boiling point lower than the first, and

delivering a second chilled refrigerant at a second refrigeration energy rate selectively related to the first to provide a cumulative refrigeration energy rate to achieve a desired thermal exchange rate with a thermal transfer fluid.

2. The method as set forth in claim 1 above, wherein the first refrigerant has a boiling point such that the first refrigerant is liquid at ambient temperature and pressure and the second refrigerant is a gas at ambient temperature and pressure.

3. The method as set forth in claim 1 above, further including the step of heating the thermal transfer fluid independently to provide fluid temperatures at and above ambient after effecting thermal energy transfer between the first and second refrigerants.

4. The method as set forth in claim 1 above, wherein the steps of chilling both the first and second refrigerants comprise compressing and subsequently condensing the refrigerants, wherein the step of condensing the second refrigerant comprises using the first chilled refrigerant for heat extraction to condense the compressed second refrigerant, and wherein the refrigeration rates are established by selective expansion of the compressed refrigerants to a liquid-vapor phase.

5. The method as set forth in claim 5 above, wherein the step of condensing the first refrigerant comprises passing a first cooling medium in heat exchange relation with the compressed first refrigerant, and the step of condensing the second refrigerant includes in part passing the compressed second refrigerant in heat exchange relation with the first cooling medium prior to thermal energy transfer between the two refrigerants.

6. The method as set forth in claim 5 above, wherein both the first refrigerant and second refrigerant are lowered in temperature by the condensation steps to below their boiling points and the method further comprises the step of evaporating the liquid-vapor mixtures of the second refrigerant at ? controlled rates for control of the temperature of the thermal transfer fluid.

7. The method as set forth in claim 6 above, wherein the evaporated refrigerants are returned for compression and the method includes the further steps of subcooling the first and second refrigerants separately by thermal exchange between returned expanded gases and compressed liquefied refrigerant.

8. The method as set forth in claim 5 above, wherein the first cooling medium for the first chilled refrigerant is air and the method further comprises extracting thermal energy from the second refrigerant with air prior to exchanging thermal energy between the first and second refrigerants.

9. The method as set forth in claim 5 above, wherein the cooling medium for the first chilled refrigerant is water, and wherein the second refrigerant is partially condensed by the step of air cooling before thermal energy interchange with the first refrigerant in liquid-vapor form.

10. The method as set forth in claim 1 above, wherein the first and second refrigerants are each compressed to pressurized gases, then condensed to liquid, and controllably expanded to liquid-vapor states and subsequently evaporated in thermal energy exchange with a subsequent medium.

11. A system for controlling the temperature of process equipment by using a thermal transfer fluid flowing therethrough, comprising:

a first refrigeration module employing a first refrigerant having a given vapor point temperature, and including a compressor, a condenser and a first controllable expansion device for providing a pressurized liquid/vapor mixture for a first refrigeration effect;

a second refrigeration module employing a second refrigerant having a second vapor point temperature lower than said given vapor point temperature, and including a second compressor for pressurizing the second refrigerant in gaseous form, a condenser/heat exchanger interchanging thermal energy between

the liquid/vapor mixture from the first refrigeration module and the pressurized second refrigerant to provide the second refrigerant as a pressurized liquid, a second controllable expansion device for providing a second pressurized liquid/vapor mixture for modifying the level reached with the first refrigeration effect, and a second heat exchanger receiving thermal transfer fluid flowing through the process equipment, and interchanging thermal energy between the second pressurized liquid/vapor mixture and the thermal transfer fluid.

12. A system as set forth in claim 11 above, wherein the first refrigeration module includes an air circulating device and wherein the second refrigeration module includes a conduit including a thermally conductive section for pressurized gaseous refrigerant from the compressor, the conductive conduit section being disposed in the path of air circulated by the air circulating device.

13. A system as set forth in claim 12 above, wherein the first and second refrigeration modules are disposed in adjacent relation, and the first module includes an air cooled condenser including a fan, and the conductive conduit section comprises finned tubing in the path of air convected by the fan.

14. A system as set forth in claim 11 above, wherein the first and second modules have like form factors and wherein the system includes supply and return conduits extending from the first expansion device in the first module to the condenser/heat exchanger in the second module, and the second module comprises a shunt loop from the second compressor to adjacent the condenser in the first module.

15. A system as set forth in claim 11 above, wherein the condenser in the first module is water cooled, and wherein the first module includes an air blower providing a flow toward the second module and the second module includes a conduit for pressurized gas refrigerant from the second compressor disposed in the flow of air from the air blower.

16. A refrigeration system employing a low boiling point oil-containing refrigerant that is a gas at ambient temperature, for cooling a thermal transfer fluid to be used in cooling process equipment comprising:

a compressor having a suction input and providing a pressurized refrigerant output;

an oil separator receiving the refrigerant output and returning a substantial part of the oil therein to the compressor input;

a condenser system receiving the pressurized refrigerant output from the oil separator and providing a pressurized liquid refrigerant output;

a counterflow subcooler receiving the pressurized liquid refrigerant as one input and returning suction input refrigerant as a second input;

an excess volume cylinder coupled to receive a restricted flow of gaseous refrigerant from the suction input refrigerant to limit pressure buildup;

a heat exchanger/evaporator coupled to receive pressurized refrigerant and the thermal transfer fluid separately, but in heat exchange relation, and

an expansion valve device coupled to receive the pressurized liquid refrigerant from the subcooler and providing a selected mixture of expanded liquid/vapor to the heat exchanger/evaporator.

17. A refrigeration system as set forth in claim 16 above, wherein the system includes a controller providing commands for the expansion valve device, the expansion valve device including both a solenoid expansion valve and a thermal expansion valve, and wherein the system includes pressure relief elements coupled separately to pressurized gas refrigerant lines and pressurized liquid refrigerant lines.

18. A refrigeration system as set forth in claim 16 above, and including in addition a hot gas bypass valve responsive to input suction temperature and coupling the compressed gas output from the oil separator to the suction input and a desuperheater valve responsive to suction input pressure and selectively coupling pressurized liquid refrigerant to the suction input in the event of suction input being below a selected threshold.

19. A system for providing, in response to command signals, a controllable flow of refrigerant in a liquid/vapor state to an evaporative heat exchanger from an input flow of pressurized liquid refrigerant, comprising:

a solenoid operated expansion valve having a given orifice size for full flow output operation; the solenoid operated valve being operable at a controllable duty cycle in response to command signals;

a thermal expansion valve coupled to receive the output from the solenoid operated expansion valve, the thermal expansion valve having a variable orifice that is electrically controllable by command signals to modulate the liquid/vapor mixture to be provided to the evaporative heat exchanger; and

a temperature sensing device in thermal communication with and responsive to temperature levels in the refrigerant after passing through the evaporative heat exchanger for adjusting the variable orifice setting to obtain the desired output temperature from the evaporative heat exchanger.